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Key to Mites Commonly Associated With the Southern Pine Beetle[1]

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This paper outlines a method of preparing mites for microscopic examination and contains a simple key to the 15 species of mites commonly associated with the southern pine bark beetle. Research workers wanting to identify these mites and others curious about them, but untrained in acarology, should find little difficulty in making identifications.

Additional keywords: Acari, phoresy, *Dendroctonus frontalis*.

Current interest in the biology and ecology of the southern pine beetle, *Dendroctonus frontalis* Zimm., has created a need for a key that will help novices identify the minute organisms associated with the beetle. The Acari, or mites, are a group of associates that are unfamiliar to many investigators. The relationship between the mites and these pine beetles is a special form of commensalism called phoresy: the mites cling to the beetles to disperse themselves but do not directly harm the beetle. Moser and Roton (1971) list 96 species of mites associated with bark beetles in the southern United States, but only 15 species (table 1) are commonly phoretic on *D. frontalis*.[2] The key is to the life stage (nymph or adult) that occurs on the adult beetle. Other life stages of the mite occur in the beetle galleries.

A good hand lens or dissecting microscope will reveal characteristics that allow one to identify the families and superfamilies, but mounted specimens are needed for species identification. Color and behavior characteristics have been described, and illustrations of each specimen have been included. Few morphological terms are used, and the reader will find it easy to become familiar with those that are.

MOUNTING SPECIMENS

Specimens to be mounted on slides should be cleared in a lacto-phenol solution held at room temperature for 24 hours or placed in a 60°C (140°F) oven for 12 hours. The clearing agent is prepared by mixing:

Lactic acid . . . . . 50 parts
Phenol crystals . . . . . 25 parts
Distilled water . . . . . 25 parts.

Berlese's solution is a convenient mounting medium and contains:

Gum acacia (crystals of gum arabic) . . . . . 40 g
Distilled water. . . . . 40 ml
Glycerin . . . . . 25 ml
Chloral hydrate . . . . . 350 g
Glacial acetic acid. . . . . 15 ml.

This medium is prepared in the following manner:

1. Completely dissolve gum acacia in distilled water. This process is slow

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2 Moser, J. C. 1976. Personal conversation. South. For. Exp. Stn., Pineville, La.

Table 1.—*Species and stages of mites commonly phoretic on the southern pine beetle.*

Order Parasitiformes
- Suborder Mesostigmata
  - Superfamily Parasitoidea
    - Ascidae - females phoretic
      - *Proctogastrolaelaps libris* McGraw and Farrier 1969
      - *Proctolaelaps dendroctoni* Lindquist and Hunter 1965
    - Digamasellidae - deutonymphs phoretic
      - *Longoseius ciniculus* Chant 1961
      - *Dendrolaelaps neodisetus* (Hurlbutt 1967)
    - Macrochelidae - females phoretic
      - *Macrocheles boudreauxi* Krantz 1965
  - Superfamily Uropodoidea
    - Uropodidae - deutonymphs phoretic
      - *Trichouropoda australis* Hirschmann 1972
      - *Trichouropoda hirsuta* Hirschmann 1972

Order Acariformes
- Suborder Astigmata
  - Superfamily Acaroidea
    - Acaridae - deutonymphs (hypopi) phoretic
      - *Histiogaster arborsignis* Woodring 1963
  - Superfamily Anoetoidea
    - Anoetidae - deutonymphs (hypopi) phoretic
      - *Anoetus sordida* Woodring and Moser 1970
      - *Anoetus varia* Woodring and Moser 1970
- Suborder Prostigmata
  - Superfamily Tydeoidea
    - Ereynetidae - adults phoretic
      - *Ereynetoides scutulis* Hunter 1964
  - Superfamily Tarsonemoidea
    - Pyemotidae - females phoretic
      - *Pygmephorus bennetti* Cross and Moser 1971
    - Tarsonemidae - females phoretic
      - *Heterotarsonemus lindquisti* Smiley 1969
      - *Tarsonemus ips* Lindquist 1969
      - *Tarsonemus krantzi* Smiley and Moser 1974

and may take as long as 5 days but can be shortened to about 3 hours with constant agitation. Add more water if solution does not dissolve.

2. Dissolve other ingredients in the order listed above.
3. Strain the solution through several layers of cheese cloth using a wide-mouth funnel, and then centrifuge at high speed for 45 minutes.
4. The final solution should have the consistency of honey, which is produced by heating the solution in an oven at 50°C (122°F).

The following procedure for mounting mite specimens on microscope slides is suggested:

1. Place a small drop of Berlese's medium on a clean slide.
2. Remove mite from lacto-phenol with a

needle forceps, transfer it to the slide, and carefully push it to the bottom of the droplet.

3. Carefully place a clean coverslip over the droplet with a forceps; the medium should just reach the edge of the coverslip. Attempt to center the specimen and extend its legs by gently applying pressure to the cover slip.
4. Place the slide in a drying oven overnight at 60°C (140°F).
5. Remove the slide from the oven and scrape off the excess medium with a scalpel, then seal the coverslip by ringing with a compound such as Glyptal®[3] electrical paint.

Baker and Wharton (1952) describe other mounting media, as do Evans, Sheals, and MacFarlane (1961) and Krantz (1970). Specimens mailed to specialists should not be cleared or mounted, but preserved in alcohol.

KEY TO MITES

1. Discernible without the aid of a lens; often red-brown in color; body hardened, with many shields or plates; stigmata (respiratory openings) located lateral to the bases of legs III and IV; tritosternum present; special sensory hairs not present on dorsal surface (fig. 1)... Order Parasitiformes---
Suborder Mesostigmata . . . . . 2.

- Usually small and light in color; body without numerous plates; stigmata not located lateral to bases of legs III and IV; tritosternum absent; special sensory hairs may be present on the anterior dorsal surface (fig. 4)...
Order Acariformes . . . . . 8.

2. Turtle shaped; legs can be withdrawn into grooves (fig. 2); attached to beetle by anal pedicle...Superfamily Uropodoidea---
Family Uropodidae . . . . . 3.

- Not turtle shaped; leg grooves absent; attached to beetle by the mouthparts and/or leg claws...
Superfamily Parasitoidea . . . . . 4.

3. Anal shield with 14 hairs (fig. 2a); length about one-tenth of host's length
. . . . . *Trichouropoda australis*

- Anal shield with 10 hairs (fig. 2b); length about one-third of host's length
. . . . . *Trichouropoda hirsuta*

4. Large red-brown mite lacking claws on leg I; peritremes looped, joining stigmata posteriorly (fig. 1c)...Family Macrochelidae
. . . . . *Macrocheles boudreauxi*

- Leg I with claws; peritremes not looped, joining stigmata anteriorly (fig. 1b)
. . . . . 5.

5. Dorsal shield entire; posterior end rounded (fig. 3a)...Family Ascidae
. . . . . 6.

- Dorsal shield divided into two plates; posterior end more or less truncated (fig. 3b)...Family Digamasellidae
. . . . . 7.

6. Ventral surface with four shields (sternal, genital, ventral, and anal) (fig. 1a)
. . . . . *Proctogastrolaelaps libris*

- Ventral surface with three shields (sternal, genital, and anal) (fig. 1b)
. . . . . *Proctolaelaps dendroctoni*

7. Body about two times longer than wide (fig. 3b)
. . . . . *Dendrolaelaps neodisetus*

- Body about four times longer than wide (fig. 3c)
. . . . . *Longoseius cuniculus*

8. Mouthparts functional; anal suckers absent; special sensory hairs present on anterior dorsal surface (fig. 4)... Suborder Prostigmata
. . . . . 9.

- Mouthparts vestigial; anal suckers present; special sensory hairs not present on anterior dorsal surface (fig. 5)... Suborder Astigmata
. . . . . 13.

[3] Trade names are included to identify materials used and do not constitute endorsement by the U.S. Department of Agriculture.

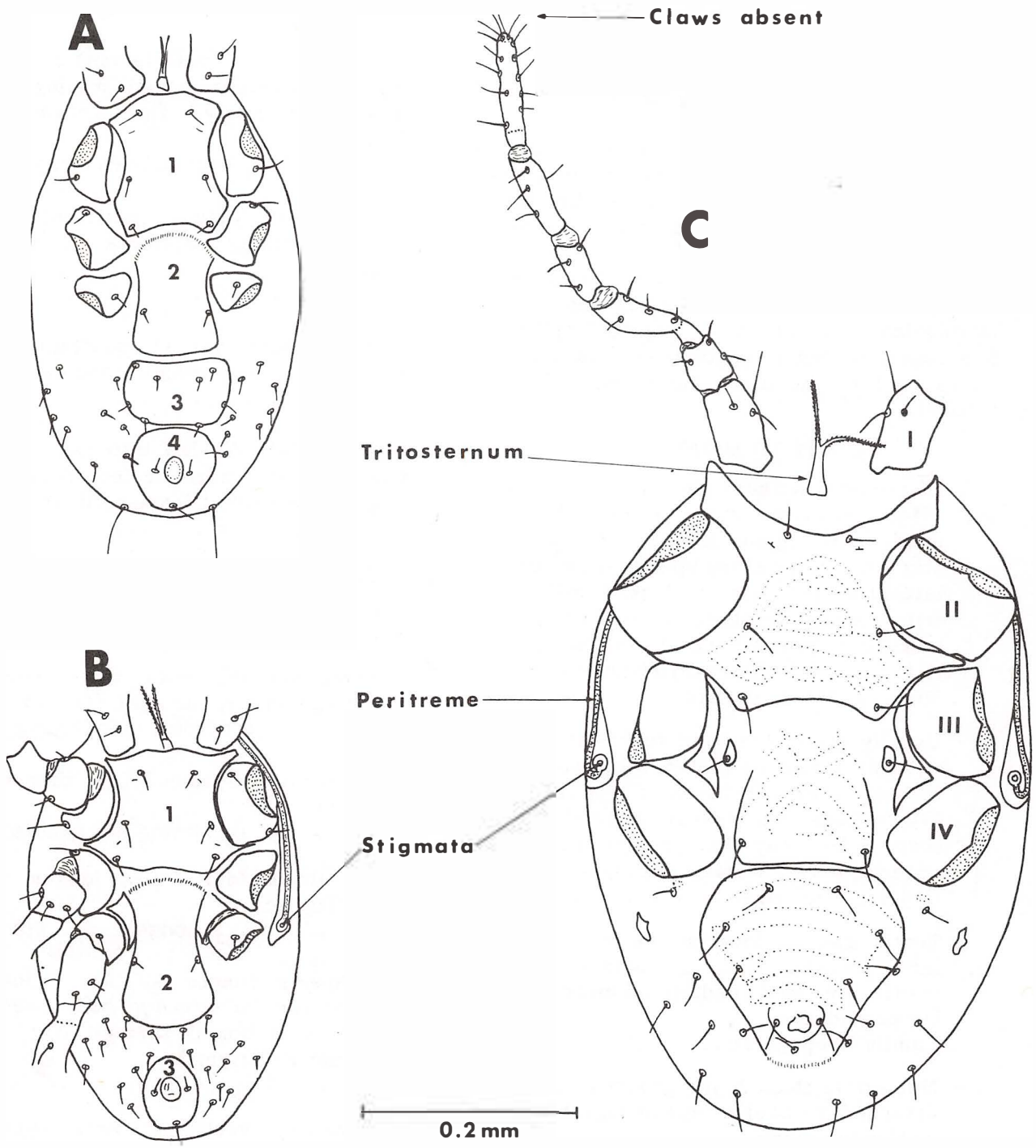

Figure 1.--Ventral aspect of (A) *Proctogastrolaelaps libris*, (B) female *Proctolaelaps dendroctoni*, (C) female *Macrocheles boudreauxi*.

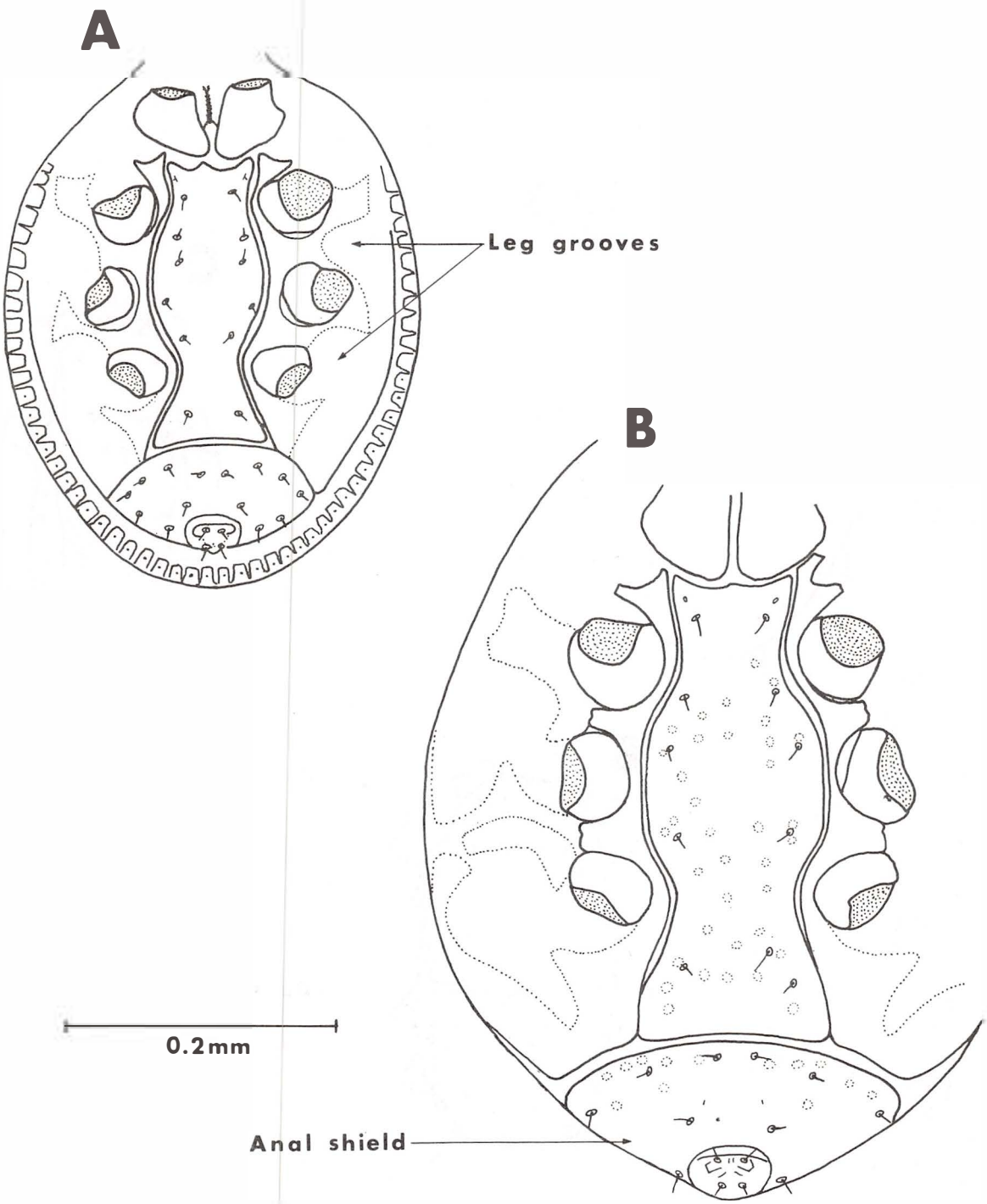

Figure 2.--Ventral aspect of (A) *Trichouropoda australis* deutonymph, (B) *T. hirsuta* deutonymph.

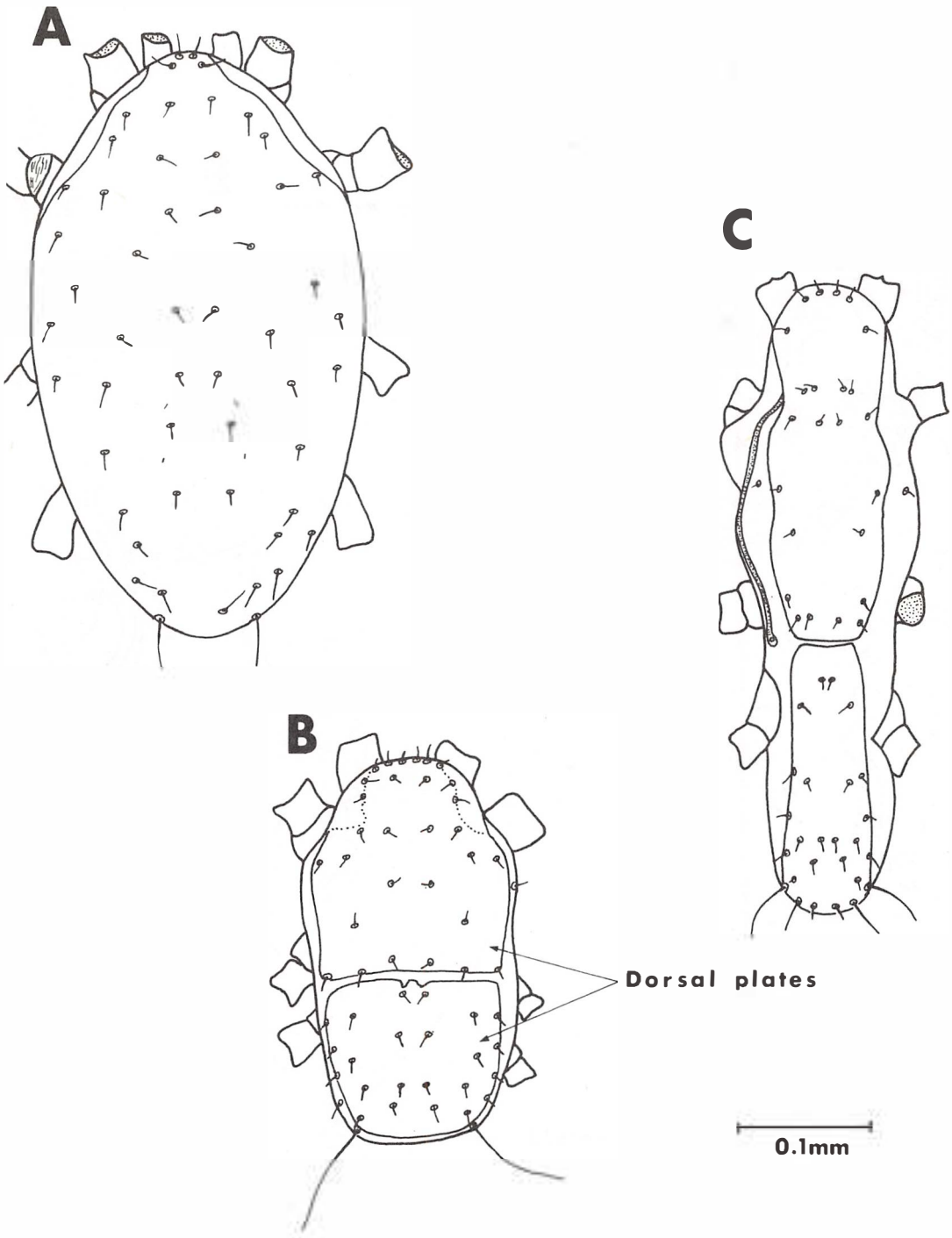

Figure 3.--Dorsal aspect of (A) *Proctolaelaps* sp., (B) *Dendrolaelaps neodisetus* deutonymph; (C) *Longoseius cuniculus* deutonymph.

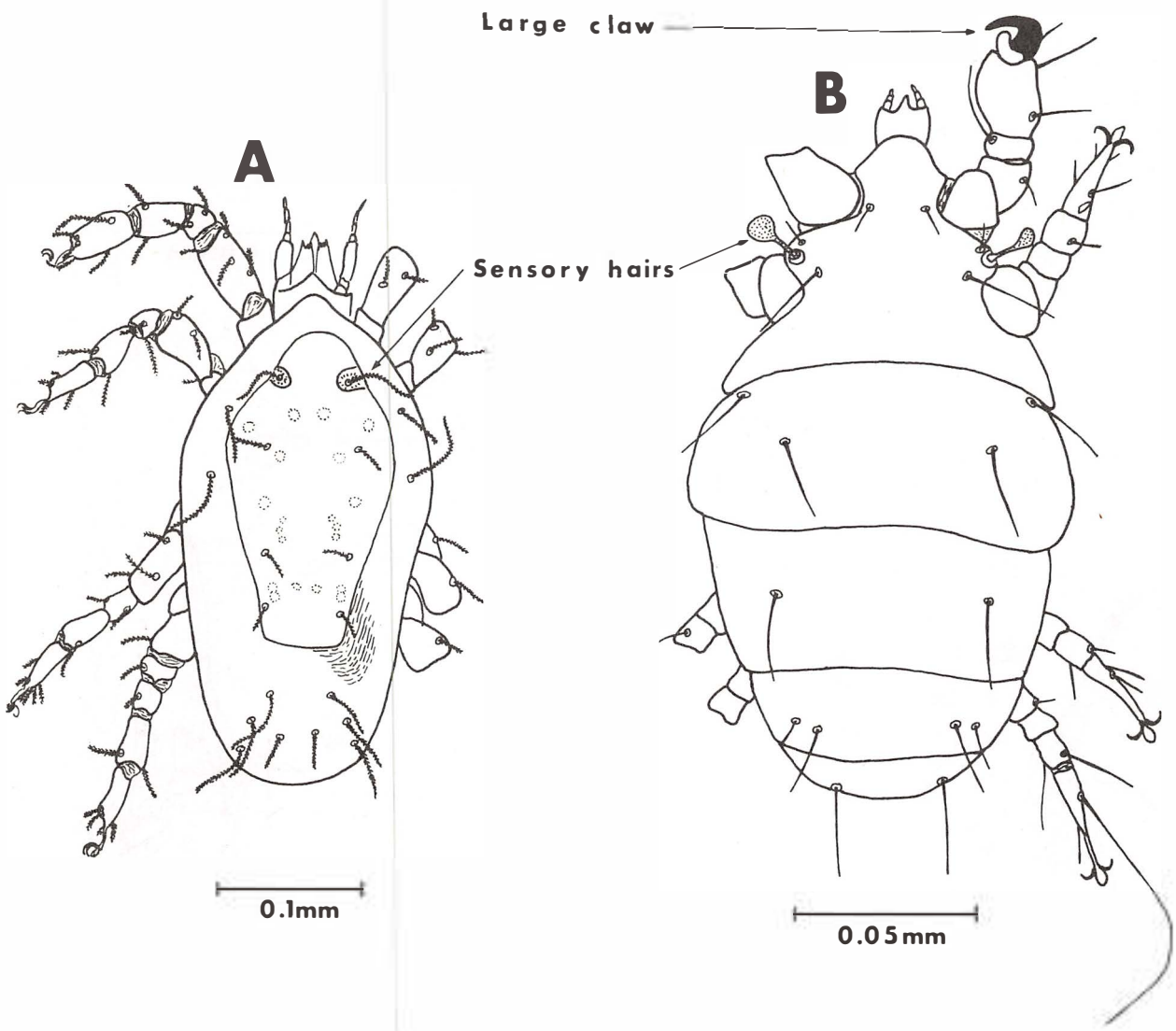

Figure 4.--Dorsal aspect of (A) *Ereynetoides scutulis*, (B) *Pygmephorus bennetti*.

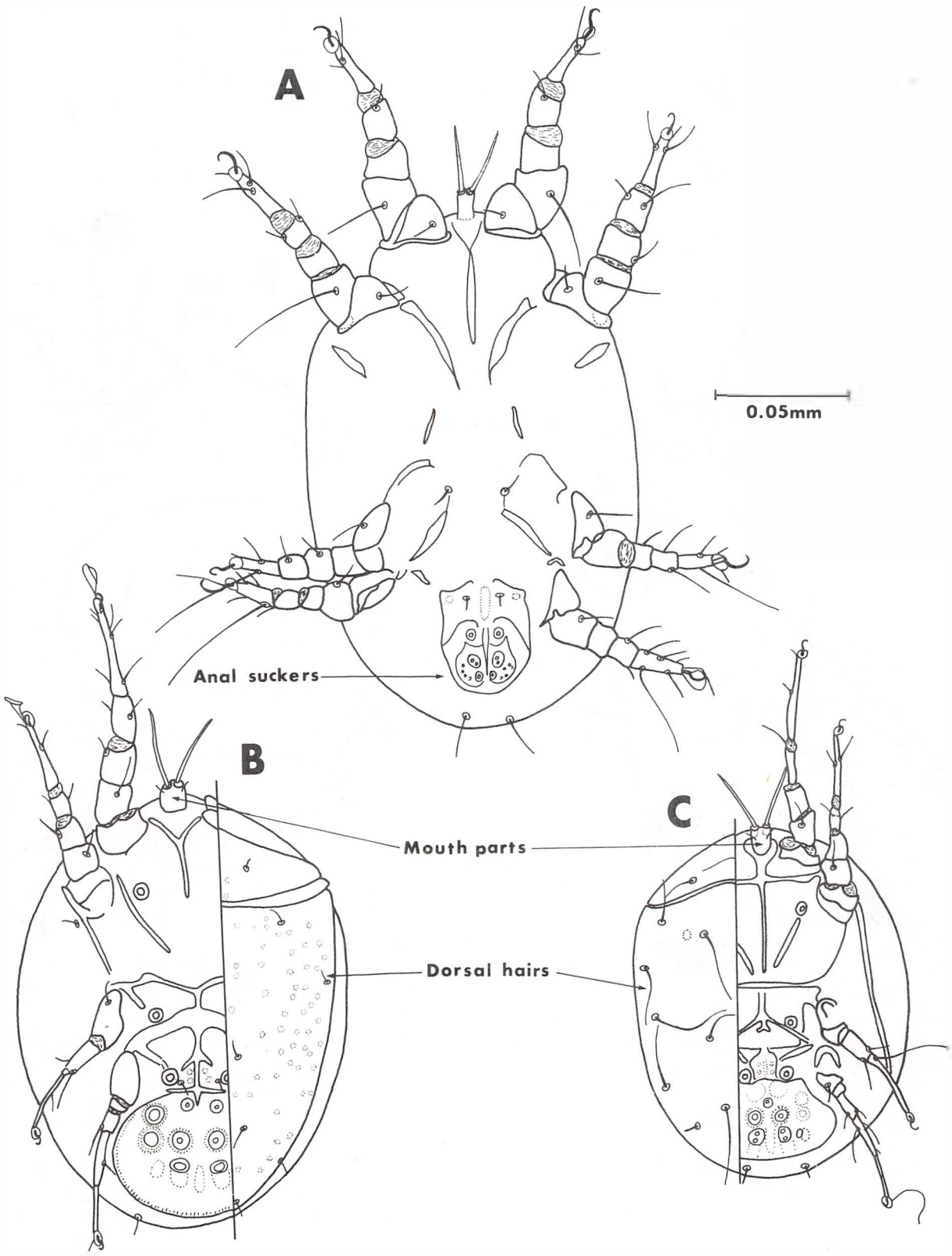

Figure 5.—Ventral aspect of (A) *Histiogaster arborsignis* hypopus, (B) *Anoetus sordida* hypopus, (C) *Anoetus varia* hypopus.

9. Small, slow-moving mites often found under the beetle's wing covers or around the leg bases; mouthparts indistinct; sensory hairs club-shaped; legs short in relation to body (figs. 4b and 6)...Superfamily Tarsonemoidea
. . . . . 10.

- Fast-moving, orange-colored mite; mouthparts distinct; sensory hairs long and barbed; legs long in relation to body (fig. 4a)...Superfamily Tydeoidea-Family Ereynetidae
. . . . . *Ereynetoides scutulis*

10. Legs IV without claws and terminating with two whiplike hairs (fig. 6)...Family Tarsonemidae
. . . . . 11.

- Legs II-IV terminating with two claws; legs I terminate with a single large claw (fig. 4b)...Family Pyemotidae
. . . . . *Pygmephorus bennetti*

11. Legs II and III with a single claw; claw of leg I short, stout, and straight (fig. 6a)
. . . . *Heterotarsonemus lindquisti*

- Legs II and III each with two claws; claw of leg I single, not modified (fig. 6b, c)
. . . . . 12.

12. Cuticular thickenings anterior to bases of legs III extending laterally beyond bases of legs III; lobe between bases of legs IV not elongated (fig. 6b)
. . . . . *Tarsonemus krantzi*

- Cuticular thickenings anterior to bases of legs III not extending laterally beyond bases of legs III; lobe between bases of legs IV very elongated and extending behind bases of legs IV (fig. 6c)
. . . . . *Tarsonemus ips*

13. All legs short and stout; legs III and IV often directed backward; distal segments of legs III and IV short (fig. 5a)...Superfamily Acaroidea - Family Acaridae
. . . . . *Histiogaster arborsignis*

- Legs I and II stouter than legs III and IV; legs III and IV often directed forward and have long, slender distal segments (fig. 5b, c)...Superfamily Anoetoidea - Family Anoetidae
. . . . . 14.

14. Entire dorsal surface always ornamented; fused mouthparts project well beyond body outline; dorsal hairs short and slender (fig. 5b)
. . . . . *Anoetus sordida*

- Dorsal ornamentation variable; fused mouthparts do not usually project beyond anterior edge of body; dorsal hairs long and thick (fig. 5c)
. . . . . *Anoetus varia*

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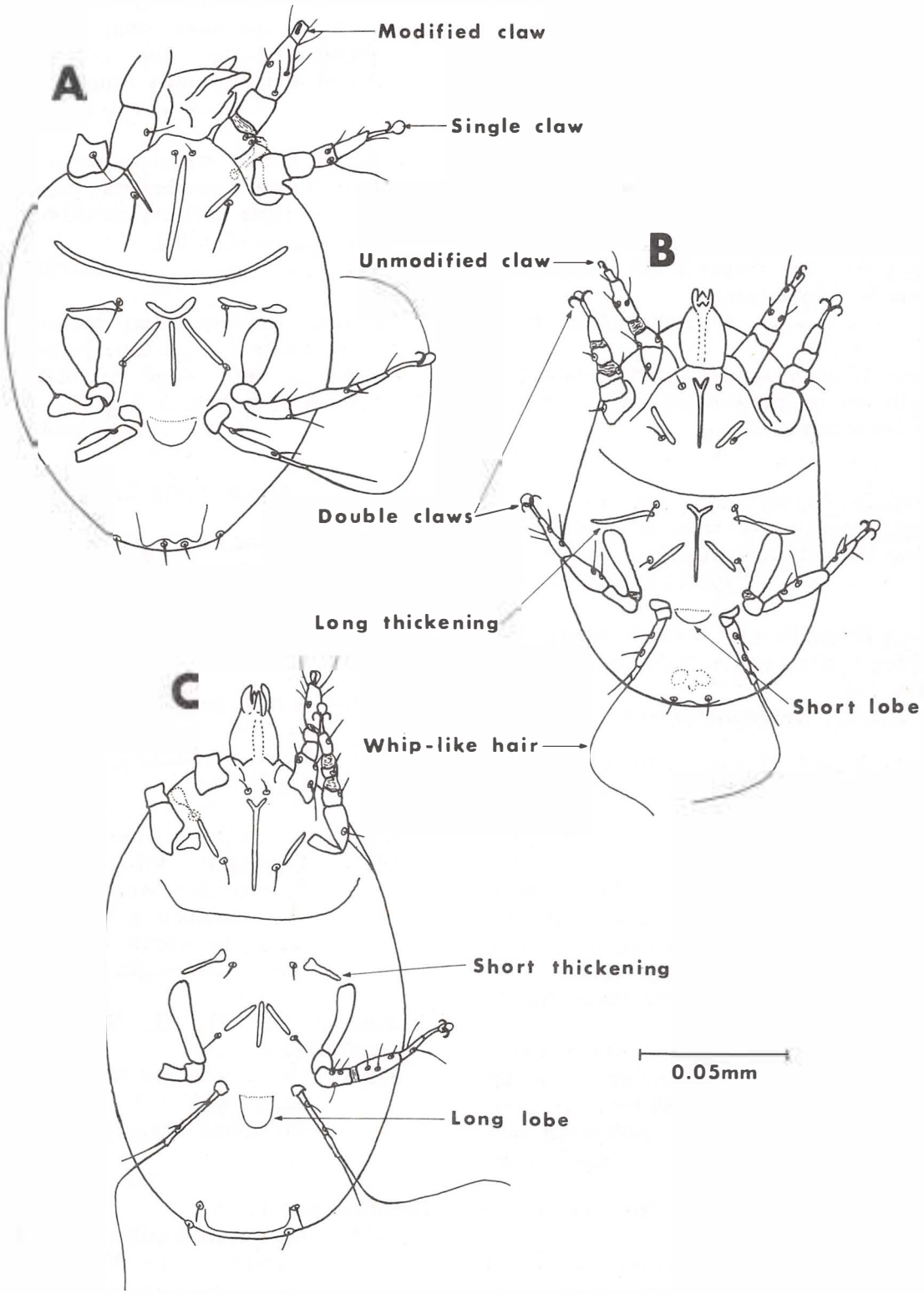

Figure 6.--Ventral aspect of (A) female *Heterotarsonemus lindquisti*, (B) female *Tarsonemus krantzi*, (C) female *Tarsonemus ips*.

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